CLAIMS

1. A method for determining and representing in real time the polarization profile of a scene, comprising:

providing four systems having light attenuating optical elements;

simultaneously sending rays of light incoming from the scene through all the systems, thereby creating four sets of attenuated rays;

passing the sets of attenuated rays through a color filter;

passing the sets of attenuated rays to a camera CCD array which forms an image from each of the sets of rays, each of the images having a matrix of pixel values, wherein a given pixel value in one of the images has corresponding pixel values in all others of the images and corresponding sets of pixel values relate to same points in the scene;

calibrating a mathematical relation between the pixel values and intensity values;

converting the matrices of the pixel values to matrices of the intensity values;

using the matrices of intensity values to derive matrices of Stokes parameters S_0, S_1, S_2, and S_3;

converting the parameter values S_1, S_2, and S_3 into values for colors unique for each of the parameters by the formula $C = \text{int}[127.5(1-S)]$ where C is a color and S is S_1, S_2, or S_3;

using the unique values to create a color map of the scene which represents the polarization characteristics of the scene.

2. The method of claim 1 wherein:

the four systems are a first, second, third and fourth optical element set;

the first system comprises a first linear polarizer whose transmission axis is oriented at an angle θ_1 with an x_1-z_1 plane along which the incoming light passes;

the second system comprises a second linear polarizer whose transmission axis is oriented at an angle θ_2 with an x_2-z_2 plane along which the incoming light passes;

the third system comprises a third linear polarizer whose transmission axis is oriented at an angle θ_3 with an x_3-z_3 plane along which the incoming light passes;

the fourth system comprises a retarder whose fast axis is oriented at an angle Ω with an x_4-z_4 plane along which the incoming light passes; the fourth system further comprising a fourth linear polarizer whose transmission axis is oriented at an angle θ_4 with the x_4-z_4 plane.

3. The method of claim 1 wherein the step of calibrating the mathematical relation comprises:

passing a beam of collimated light through neutral density filters of different known optical densities and recording the pixel value for each known intensity value for the collimated light; and

curve fitting to yield the optical density, Y, as a function of the pixel value, X, to obtain a function f(X); and

substituting f(X) for Y in the equation $I = 10^{-Y}$, where I is the intensity.

4. The method of claim 1 wherein the step of converting the parameter values S_1, S_2, and S_3 utilizes the colors red, green and blue for the value C and the parameters are

each associated with one of the colors.

5. A method for determining and representing in real time the polarization profile of a scene, comprising:

providing four systems having light attenuating optical elements;

simultaneously sending rays of light incoming from the scene through all the systems, thereby creating four sets of attenuated rays;

passing the sets of attenuated rays through a color filter;

passing the sets of attenuated rays to a camera CCD array which forms an image of each of the sets of rays, each of the images having a matrix of pixel values, wherein a given pixel value in one of the images has corresponding pixel values in all others of the images and wherein corresponding sets of pixel values relate to same points in the scene;

calibrating a mathematical relation between the pixel values and intensity values;

converting the matrices of the pixel values to matrices of the intensity values;

using the matrices of intensity values to derive matrices of Stokes parameters S_0, S_1, S_2, and S_3;

for selected points in the scene, deriving a set of calculated values for one or more of P, ψ or χ, where P is the degree of polarization, ψ is the polarization azumith angle and χ is the polarization ellipticity angle;

converting one or more of the sets of the calculated values into eight bit digital representations; and

for one or more of the sets of the calculated values, using the eight bit representations to create a grey scale representation of the selected points of the scene.